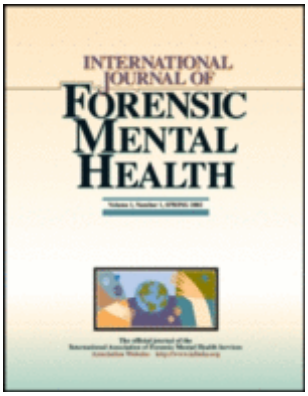
Protective factors in violence risk assessment



Protective factors in violence risk assessment: predictive validity of the SAPROF and HCR-20V3

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Abstract

Research and practice in violence risk assessment in forensic mental health primarily focuses on risk factors; however consideration of protective factors may improve the accuracy and utility of assessments. Using a pseudo-prospective design, the predictive and incremental validity of protective factors was explored using the Structured Assessment of Protective Factors (SAPROF) and Historical Clinical Risk Management-20 (HCR-20^{V3}) in 75 male inpatients in a secure setting. Over a twelve month period, protective factors significantly predicted the absence of inpatient (institutional) violence and risk factors, particularly dynamic factors, predicted the presence of violence. Hierarchical logistic regression did not establish the incremental validity of the SAPROF. Preliminary evidence for the predictive and incremental validity of the Integrative Final Risk Judgment was found with individuals judged high risk being almost seven times more likely to engage in violence than those assessed as moderate risk. High risk ratings were associated with fewer protective factors and more risk factors. Therefore, whilst dynamic risk factors are clear targets for risk management, consideration of protective factors may contribute to overall estimates of risk and provide additional targets for intervention.

Keywords: violence risk, assessment, protective factors, SAPROF, HCR-20

Predictive validity of the SAPROF and HCR-20^{V3}

The accurate assessment and management of violence risk is a core task in forensic mental health settings, a sector which has expanded rapidly across North America and Western Europe in recent decades (Jansman-Hart, Seto, Crocker, Nicholls, & Côté, 2011). Risk assessments inform decision making regarding risk management in inpatient settings. Institutional violence within inpatient settings has personal consequences and considerable organisational costs, including disrupting programme delivery, reducing the quality of service provision, and potentially impacting negatively on staff turnover, morale, motivation, and absenteeism rates (Gadon, Johnstone, & Cooke, 2006). There is therefore a need for defensible practice and decision making to effectively prevent future violent behaviour (Risk Management Authority, 2007).

A recent study by Singh et al. (2014) indicated some of the most widely used and evidence based tools in violence risk assessment practice were based on the structured professional judgment (SPJ) approach. SPJ tools were also rated by mental health practitioners as being very useful in risk management planning and monitoring. The SPJ approach involves identifying the presence and relevance of risk factors in the individual case, integrating these into a risk formulation and scenarios, and using these to inform risk management (Douglas, Blanchard, & Hendry, 2013; Douglas, Hart, Webster, & Belfrage, 2013). An overall level of risk (referred to as the summary risk judgment, estimate or rating) is given using the assessor's professional judgment (Douglas, Ogloff, & Hart, 2003). Although a number of SPJ risk assessment tools exist, most focus on *risk* factors which are associated with an increased risk of violence, rather than *protective* factors associated with a decreased risk of violence.

Existing research on protective factors and related concepts such as resilience and desistance highlights a lack of clarity and consensus regarding how the concepts are defined

and conceptualised (Farrington, 2007; Jones & Brown, 2008; Lösel & Farrington, 2012). Protective factors have been conceptualised in different ways (de Vogel, de Vries Robbé, de Ruiter, & Bouman, 2011) and the literature lacks clear theoretical models to explain the mechanisms by which protective factors might operate to reduce risk of violence (Rogers, 2000). Many protective factors appear to reflect opposing ends of the same continuum with inter-dependant corresponding risk factors, and use the same evidence for rating the presence of the factors. For example, the protective factor "self-control" and the risk factor "impulsivity" are likely to be highly correlated which makes it difficult to determine the relative merit of each.

In the field of violence risk assessment, Wilson, Desmarais, Nicholls, and Brink (2010) commented "the amount of attention devoted to considering the role of protective factors has been nothing short of trivial." (p. 283). It has been suggested that the consideration of protective factors within violence risk assessment could lead to more accurate, balanced and comprehensive assessments (Rogers, 2000; Ryba, 2008). Identification of protective factors could also inform decisions regarding areas for intervention as well as facilitate motivation and engagement in forensic clients (de Vries Robbé & Willis, 2017; Ullrich & Coid, 2011). Although these propositions have face validity, there is a lack of empirical support in the extant literature. O'Shea and Dickens (2016) conducted a systematic review and meta-analysis of the predictive efficacy of protective factors; they found no significant difference between the predictive validity of risk and protective factors and highlighted that the evidence base for protective factors was limited. The lack of clarity in defining and conceptualising protective factors has likely contributed to limitations in the existing evidence base and makes successfully incorporating protective factors into violence risk assessment practice challenging (Fortune & Ward, 2017; Klepfisz, Daffern, & Day, 2017).

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Whilst the majority of SPJ violence risk assessment tools include only risk factors, some well-established tools also include protective factors. For example, the Structured Assessment of Violence Risk in Youth (SAVRY; Borum, Bartel, & Forth, 2002) includes six protective factors covering areas such as social support, attachments, and attitudes towards intervention and authority. The Short Term Assessment of Risk and Treatability (START; Webster, Martin, Brink, Nicholls, & Middleton, 2004) instructs assessors to consider all 20 factors as both vulnerabilities (risks) and strengths (protective factors) and includes items such as social skills, emotional state, material resources, and insight. Whilst a number of studies have been conducted to explore the predictive validity of both tools, those which reported the predictive validity of the protective factor scales suggest variable findings (e.g. Braithwaite, Charrette, Crocker, & Reyes, 2010; Desmarais, Nicholls, Wilson, & Brink, 2012; Dolan & Rennie, 2008; Lodewijks, de Ruiter, & Doreleijers, 2010). In addition to these risk assessment tools, the Dangerousness Understanding, Recovery and Urgency Manual (DUNDRUM; Kennedy, O'Neill, Flynn, & Gill, 2010) also considers factors within two scales (DUNDRUM-3 Programme Completion and DUNDRUM-4 Recovery) which are similar to protective factors. These scales are used to inform decision making in terms of the level of security and support patients require in forensic mental health settings and include items such as mental health, insight and therapeutic rapport. Although not a risk assessment tool per se, the DUNDRUM-3 and DUNDRUM-4 have been shown to predict (absence of) inpatient violence (Abidin et al., 2013).

One risk assessment tool designed to specifically assess protective factors for violence risk is the Structured Assessment of Protective Factors (SAPROF – 2nd version; de Vogel, de Ruiter, Bouman, & de Vries Robbé, 2012). Initially developed in 2004 and first published in 2007, the SAPROF is an SPJ tool developed for use alongside other tools which assess risk

factors for violence. The SAPROF protective factors were identified through review of the literature and items proposed by experienced clinicians. The protective factors are primarily dynamic in nature and conceived as being associated with an absence of violence.

Initial studies have reported that the SAPROF total score and overall judgments of risk have significantly predicted the absence of convictions for violence and in-patient violence (Abidin et al., 2013; Persson, Belfrage, Fredriksson, & Kristiansson, 2017; de Vries Robbé, 2014; de Vries Robbé, de Vogel, & de Spa, 2011; de Vries Robbé, de Vogel, & Douglas, 2013; de Vries Robbé, de Vogel, Koster, & Bogaerts, 2015). Analyses exploring whether the SAPROF has incremental validity when used alongside SPJ tools focusing on risk factors vary, with significant outcomes depending on the length of the follow-up period and the type of violence being predicted (de Vries Robbé et al., 2013; de Vries Robbé, de Vogel, Koster, & Bogaerts, 2015). In the only study to examine the effect of change in the presence of SAPROF protective factors over time, an increase in protective factors following inpatient treatment was found to be associated with an absence of violence in the community in a sample of male forensic psychiatric patients (de Vries Robbé, de Vogel, Douglas, & Nijman, 2015). Other studies focusing on adolescent populations and sexual offending (Klein, Rettenberger, Yoon, Köhler, & Briken, 2015; Zeng, Chu, & Lee, 2015) found no consistent relationship between protective factors and violence although they used the adult, rather than the subsequently published adolescent version (de Vries Robbé, Geers, Stapel, Hilterman, & de Vogel, 2015). Perhaps most notably, many studies exploring the validity of the SAPROF have been conducted by the tool's authors, and may therefore be susceptible to authorship bias (Singh, Grann, & Fazel, 2013). They have also been conducted in the same setting in which the tool was initially developed and validated. It appears, therefore, that although increasingly used in clinical practice, the SAPROF's validity has yet to be firmly

Predictive validity of the SAPROF and HCR-20^{V3}

established. Further, violence risk assessment using the SPJ approach requires expertise and time (Green, Carroll, & Brett, 2010); use of additional risk assessment tools adds to the resource required and it is therefore important to establish whether including protective factors adds incremental validity.

The present study sought to explore the predictive and incremental validity of the SAPROF for inpatient violence in a secure forensic mental health setting. It was hypothesised the SAPROF would predict the absence of violent behaviour and the SAPROF and SPJ risk estimate of overall level of risk would have incremental validity over the assessment of risk factors. Risk factors were assessed using the most recent version of the Historical, Clinical and Risk Management – 20 (HCR-20^{V3}; Douglas, Hart, et al., 2013); a secondary aim of the study was therefore to explore the predictive validity of the HCR-20^{V3} and to consider the utility of the SAPROF when combined with the HCR-20^{V3}.

Method

Setting

The State Hospital provides a high secure forensic mental health service for Scotland and Northern Ireland. Patients are legally detained in the hospital due to their "dangerous, violent or criminal propensities" (The State Hospitals Board For Scotland, 2014, p. 5), including those admitted from court, prisons and other health facilities due to severe mental illness. Violence risk assessment and management planning based on the SPJ approach is well established within the hospital (Vojt, Slesser, Marshall, & Thomson, 2011).

Participants

A total of 129 male patients were detained in the hospital at the beginning of the data collection period (April 2014). Patients were eligible for inclusion in the study if they had a history of previous interpersonal violence and aggression and were aged 18 years or over, in accordance with the stated criteria of the SAPROF and HCR-20^{V3}. To ensure sufficient information was available in participant's case files to reliably rate the measures and allow for an adequate follow up period, participants were required to have been resident within the hospital for at least two years.

Seventy five patients (58.1%) met the inclusion criteria. Of the 54 patients who were excluded from the study, 59.3% (*n* = 32) were excluded on the basis of being resident in the hospital for less than two years and 40.7% (*n* = 22) had insufficient file information (for most this was due to not having a completed file review document which summarised all the individual's case files).

The average age of participants was 39.44 years (*SD* = 11.28, range 20 - 64) at the beginning of the follow-up period and the average length of time patients had been detained in hospital was 5.54 years (*SD* = 6.86, range 1.1 – 30). Most patients (*n* = 62, 82.7%) had a primary diagnosis of schizophrenia or other psychotic disorder. Other primary diagnoses included learning disability (*n* = 6, 8.0%), personality disorder (*n* = 3, 4.0%), bipolar disorder (*n* = 2, 2.7%), obsessive compulsive disorder (*n* = 1, 1.3%) and depressive disorder (*n* = 1, 1.3%). Co-morbidity was present in 49.3% (*n* = 37) of the sample; the most frequent secondary diagnoses related to substance misuse (*n* = 16, 43.2%) or personality disorder (*n* = 14, 37.8%).

In terms of forensic history, 92.0% (*n* = 69) had engaged in violence which had not resulted in a formal conviction, 77.3% (*n* = 58) had been physically aggressive in either

inpatient or custodial settings and 81.3% (*n* = 61) were noted to have previous convictions for violence with the majority of these (*n* = 52, 85.2%) rated as serious (i.e. resulting in injury which required treatment). Nearly two thirds of patients (*n* = 46, 61.3%) had been convicted or charged with murder or attempted murder and a similar number, 65.3% (*n* = 49), had been convicted or charged with offences involving weapons. Only 21.3% (*n* = 16) of the sample had been convicted or charged with sexual offences, however 48% (*n* = 36) were noted to have behaved in a sexually inappropriate or aggressive way in inpatient or custodial settings (for example, indecent exposure or inappropriate touching). With regards to non-violent offending behaviour, theft (*n* = 49, 65.3%) and minor offences such as breach of the peace and vandalism (*n* = 60, 80.0%) were common.

Measures

Demographic information and forensic history. Information relating to age, diagnosis and details of the individual's forensic history was extracted from case files.

HCR-20^{V3}. The Historical Clinical Risk Management - 20 (Version 3) (Douglas, Hart, et al., 2013) is an SPJ tool for the assessment of interpersonal violence risk in adults aged 18 years and over. The tool contains 20 risk factors which have an established empirical association with violence and are divided into three temporal domains: the Historical scale includes 10 items which reflect history of violence and past psychosocial functioning; the Clinical scale contains five items reflecting recent psychosocial adjustment; and the Risk Management scale contains five items pertaining to anticipated future psychosocial adjustment. Items are rated in terms of whether they are present for the individual being assessed and also whether they are relevant to future violence and risk management. As relevance ratings require a thorough understanding of the individual case and their previous violence, the

present study (which rated items based on case file information) focused only on presence ratings to maximise reliability and accuracy of scoring. Presence is coded using a three-level response format; it is recommended that for research purposes, each level is assigned a numerical value where 2 = definitely present; 1 = possibly or partially present; and 0 = not present. Within the HCR-20^{V3}, Historical scale presence ratings are relatively static, whereas presence ratings for Clinical and Risk Management items are regarded as dynamic and amenable to change over time. In clinical practice, ratings are integrated using professional judgment to estimate the overall risk of violence, however the authors also note "generally the more risk factors that are present and relevant, the higher the risk of future violence" (Douglas, Hart, et al., 2013, p. 62). Hence, in research, often the overall total and domain scores are included in statistical analyses.

The previous version of the HCR-20 (version 2) was widely used in clinical practice (Hurducas et al., 2014; Singh et al., 2014) and has established inter-rater reliability and predictive validity (Douglas et al., 2003; Strand, Belfrage, Fransson, & Levander, 1999; O'Shea, Mitchell, Picchioni, & Dickens, 2013). Campbell, French, and Grendreau (2009) concluded in their meta-analytic study of violence risk assessment tools that the HCR-20 (version 2) produced the largest mean effect size for institutional violence. However, Vojt, Marshall, and Thomson (2013) reported the predictive validity of the HCR-20 (version 2) completed by clinical teams in practice within the same setting as the current study was not consistently predictive of future violence. Although published validation studies of version 3 are relatively limited at present, a number of pilot studies have been conducted. Doyle et al. (2014) reported good inter-rater reliability for the total and sub-scales of the HCR-20^{V3} (ranging from .90 to .93) when rated based on collateral interview and file information. They also found the HCR-20^{V3} significantly predicted violence in patients discharged from

medium secure forensic psychiatric services in England and Wales over a six to twelve month follow-up period. Strub, Douglas, and Nicholls (2014), reported version 2 and version 3 ratings correlated highly in a civil psychiatric and offender sample and the SPJ risk estimates had good predictive validity with an AUC of .73 at six to eight month follow-up.

SAPROF. The Structured Assessment of Protective Factors (de Vogel et al., 2012) is a 17 item tool originally developed for use with males who have a history of violence and mental disorder. The SAPROF comprises three domains: the Internal scale includes five items focusing on personal characteristics; the Motivational scale includes seven items associated with the individual's motivation to participate in society in a positive manner and engage with treatment; and the External scale includes five items which focus on aspects of the individual's social network and professional management which can exert an external influence and reduce violence risk. Each item is rated on a three-point scale to reflect the degree to which it is present where 2 = clearly present; 1 = may be present or is present to some extent; and 0 = clearly absent.

The SAPROF also instructs assessors to make two SPJ estimates. The Final Protection Judgment (FPJ) is the extent to which the protective factors identified using the SAPROF reduce the risk of future violent behaviour (i.e. the relevance of the protective factors in the individual case) and the Integrative Final Risk Judgment (IFRJ) is the overall SPJ risk estimate based on the SAPROF and the other risk assessment tools which have been used. Both estimates are rated as low, moderate, or high and require the assessor to interpret and integrate the available information using their professional judgment. The SAPROF has been shown to correlate with protective factors assessed in other SPJ risk assessment tools (Abidin et al., 2013; Klein et al., 2015). Interrater reliability is generally good and for the total SAPROF score ranges from ICC = .65 (Zeng et al., 2015) to .92 (Klein et al., 2015). The

total score has been shown to predict absence of violence; in de Vries Robbé's (2014) study of inpatient aggression, the SAPROF total score had an AUC of .76. In addition, de Vries Robbé et al. (2011) report the SAPROF total, FRJ, IFRJ and the HCR-20 total minus SAPROF total score (coded based on file information) were all significantly associated with violence in forensic psychiatric patients discharged from hospital with AUC values ranging from .65 to .85.

Outcome measure. The outcome measure in the present study was incidents of inpatient (institutional) violence based on the HCR-20^{V3} definition: "actual, attempted, or threatened infliction of bodily harm [including physical and serious psychological harm] on another person." (Douglas, Hart, et al., 2013, p. 36). Incidents of violence were extracted from an existing electronic database used by staff to record all adverse incidents within the hospital; staff are required to record all adverse incidents immediately, select a category of incident based on clearly defined criteria, and provide detailed descriptions of the events. All entries are then reviewed by the hospital's risk management department to ensure accurate completion. Recorded incidents consistent with the HCR-20^{V3} definition of violence were categorised in this study as physical, verbal or sexual with an overall category of 'any violence' combining all three. Where incidents included multiple types of violence, the incident was categorised based on the type of violence that was likely to result in more harm (i.e. a greater severity of injury). For example, incidents which included physical and verbal violence (e.g. a threat to hurt an individual) were categorised as "physical" rather than "verbal". Physical violence included assaults as well as attempted assaults where staff had successfully intervened. Severity of physical violence was noted as either minor, moderate, or severe using the definitions proposed by Johnstone and Cooke (2008) to categorise institutional violence; minor physical violence included attempted violence,

moderate included violence with physical contact (for example, punching and kicking) and severe included violence resulting in physical injury requiring treatment. Only incidents where there were noted to have been explicit threats to harm were coded as verbal violence. Sexual violence was conceptualised more broadly due to the expected low base rate within the secure hospital setting and included any behaviour or verbal comments which had sexual content and which were likely to result in physical or psychological harm. In addition to incidents of violence, a fourth category labelled "disruptive behaviour" was also included to capture incidents that did not meet the definition for violence but had nonetheless required staff intervention or caused disruption within the hospital (including destruction to property or behaving in an abusive, hostile or aggressive manner). The presence of each type of violence or disruptive behaviour and the total number of incidents was recorded during data collection. In addition, the severity rating for the most severe incident of physical violence the patient engaged in during the follow-up period, the target of violent incidents (for example staff, patients or visitors), and whether incidents of violence and disruptive behaviour occurred within the first or second half of the follow-up period was also noted.

Procedure

Ethical approval. Ethical approval for the study was obtained from the West of Scotland Research Ethics Service. Approval to conduct the study within The State Hospital and to access patient information was obtained from the Hospital's Research Committee and Caldicott Guardian.

Sources of information. The HCR-20^{V3} and SAPROF were rated retrospectively from comprehensive file information. This included a case file review summarising relevant

information in medical, psychology, social work and prison files and was completed for the purposes of violence risk assessment within the hospital by an assistant or trainee psychologist. In addition to the case file review, information in key documents finalised following completion of the case file review was also considered. These key documents included multidisciplinary care and treatment plans and, where available, evidence documents for violence risk assessments (predominantly based on version 2 of the HCR-20). All information used to score the SAPROF and HCR-20^{V3} items was dated prior to the beginning of the follow-up period during which the incidents of violence were noted.

Data collection. All data collection and scoring of tools was undertaken by the first author. Data collection took place between April 2014 and May 2015 using a pseudo-prospective design. The HCR-20^{V3} and SAPROF were rated prior to collection of the outcome data from the follow-up period; therefore ratings were made 'blind' to the violence outcome. The author is trained in the use of both tools and has expertise and experience of conducting SPJ violence risk assessments.

There were two key time frames: the first related to the period during which information was reviewed to rate the HCR-20^{V3} and SAPROF items (the assessment period) and the second related to the period during which incidents of violence and disruptive behaviour were noted (the follow-up period). Guidelines within the tool manuals indicate dynamic items are typically rated based on the previous six to twelve months and assessments are generally considered valid for one year from completion. Although the length of the time frames were therefore the same for all patients, the actual dates of these time frames varied for each individual patient and was determined based on the dates of the key documents that were reviewed. The case file review provided relevant historical information and the date of the first care and treatment plan following completion of the

case file review was used to establish the beginning of the assessment period. The follow-up period began after the 12 month assessment period. This method maximised the comprehensiveness and continuity in file information and ensured only information that would have been available prior to the beginning of the follow-up period was used to rate the tools.

For both the HCR-20^{V3} and the SAPROF, domain scores and total scores were calculated by summing the item ratings. In addition, similar to previous validation studies of the SAPROF, a variable comprising the HCR-20^{V3} total score minus the SAPROF total score (HCR-20^{V3} total – SAPROF total) was calculated to reflect "violence risk…counterbalanced by the available protection" (de Vogel et al., 2012, p. 31). The IFRJ was rated with respect to the risk of violence within the hospital setting.

Interrater reliability. Both the HCR-20^{V3} and the SAPROF require a degree of knowledge and experience in violence risk assessment to rate and are generally used by clinicians. The availability of a suitably qualified and experienced second-rater to explore interrater reliability was therefore limited. In addition, accessing case file information within a high secure hospital setting also required training and security clearances. As a result, in the present study it was not possible to explore inter-rater reliability.

Statistical Analyses

All statistical analyses were conducted using IBM SPSS Statistics (version 21.0.0.0).

Omitted items. The mean number of items omitted (i.e. where it was not possible to rate the factor due to a lack of information) across both the HCR-20^{V3} and the SAPROF was 1.82 (*SD* = 1.11) per patient. The most frequently omitted items were Financial Management (*n* = 52, 69.3%) and Intelligence (*n* = 36, 48%) (both in the SAPROF) and

Personality Disorder (n = 29, 38.7%) (in the HCR-20^{V3}). Intelligence and Personality Disorder were generally not rated due to a lack of formal assessment information required to rate these items. Financial Management was rarely commented on in patient case files and may reflect limited relevance of this item in secure settings where access to money is restricted and spending is monitored. These three items were excluded from the domain and overall total scores for all patients in the sample due to the high number of omitted ratings.

Across the remaining item ratings for the entire sample (n = 2,550), 15 ratings (0.7%) could not be made due to insufficient information within the case files. Individual item ratings were not replaced, however the domain scores were pro-rated based on the mean score from the rated items (Chavance, 2004; Fox-Wasylyshyn & El-Masri, 2005).

Analyses. Descriptive statistics were conducted for the HCR-20^{V3} and SAPROF scores. The prevalence and characteristics of violence within the sample was also explored to provide base rates of violence and facilitate comparisons with other populations.

Initial analyses using the Kolmogorov-Smirnov test suggested that the HCR-20^{V3} total scores (D(75) = 0.13, p = .002) and SAPROF total scores (D(75) = 0.15, p < .001) were not normally distributed. Levene's test indicated that the variances were significantly different in the violent and non-violent group for the HCR-20^{V3} (F(1, 73) = 4.93, p = .03) and SAPROF (F(1, 73) = 10.31, p = .002) total scores. Therefore, non-parametric tests were used in statistical analyses.

To explore the relationship between risk factors, protective factors, the FPJ and IFRJ, and different types of violence, Spearman's correlation coefficients were calculated. Due to multiple comparisons, a Bonferroni corrected p-value was applied (.05/105 = corrected p is .0004). In addition, a Mann-Whitney test was conducted to compare the HCR-20^{V3} and SAPROF total scores between patients who engaged in violence and those who did not.

Predictive validity of the SAPROF and HCR-20^{V3}

Receiver Operating Characteristic (ROC) curve analyses were used to examine the predictive validity of risk factors, protective factors and SPJ estimates to predict each type of violence and disruptive behaviour. Mossman (1994) recommended ROC analysis to evaluate violence prediction and ROC curve analysis is now widely used in predictive validity research for violence risk assessment tools (Singh, Desmarais, & Van Dorn, 2013). AUC values range from 0 to 1; with .5 regarded as a chance prediction and a value of 1 reflecting a perfect discrimination. Rice and Harris (2005) suggest an AUC value of .639 is regarded as a medium effect and .714 is a large effect. In the ROC curve analysis, the HCR-20^{V3} domain and total scores, HCR-20^{V3} total – SAPROF total variable and IFRJ aimed to predict the presence of violence. The SAPROF domain and total scores and the FPJ aimed to predict the absence of violence.

In order to determine the performance of the measures in identifying higher and lower risk groups, Positive Predictive Values (PPVs) and Negative Predictive Values (NPVs) were calculated for the IFRJ for each type of violence and disruptive behaviour. The PPV is the proportion of those judged to be high risk who are subsequently violent and the NPV is the proportion of those judged to be low risk who are not violent (Singh, 2013). The PPV and NPV therefore reflect how well the SPJ estimate of risk agrees with the actual outcome. To calculate PPVs and NPVs a single cut-off threshold between the IFRJ categories is required; the moderate risk category was combined with either the low or high risk category to create two binning strategies; (1) high risk vs moderate/low risk and (2) low risk vs moderate/high risk (Singh, Grann, & Fazel, 2011).

Hierarchical logistic regression analyses explored the incremental validity of protective factors (SAPROF) and the IFRJ over risk factors (HCR-20^{V3}) in the prediction of any violence and disruptive behaviour. Risk factors were represented by summing the HCR-20^{V3} Clinical

and Risk Management scale scores to derive an HCR-20^{V3} dynamic variable; the Historical scale was excluded from the incremental validity analyses as the ROC curve analysis suggested it may not be predictive of violence within the sample and both the Clinical and Risk Management scale showed some predictive utility. The direct entry method was used and block order was informed by clinical practice: as assessment typically involves consideration of risk factors and the SAPROF can only be used in conjunction with existing risk assessment tools, the HCR-20^{V3} dynamic predictor was entered in the first block followed by the SAPROF total score in the second block. The IFRJ is proposed to integrate both risk and protective factors therefore this was added in the final block. To ease interpretation, within the regression analysis the SAPROF total score was reverse coded so that higher scores reflected the presence of fewer protective factors (and was therefore hypothesised to be associated with the presence of violence). The IFRJ is a categorical variable and high and low risk IFRJ categories were compared to the moderate risk category; the moderate risk category was identified as the baseline as this was the most frequent rating within the sample and, given the nature of the sample population and secure forensic setting, it could be argued that all patients presented at least some degree of risk. Additional analysis indicated that the assumptions had been met for the regression analyses; multicollinearity did not appear to be present and there was a linear relationship between the HCR-20^{V3} dynamic, SAPROF total, and IFRJ predictors and violence.

Finally, post-hoc analyses were conducted to explore the IFRJ categories. Pearson's chi-square analyses were conducted to explore rates of violence and disruptive behaviour across the IFRJ categories and a Bonferroni corrected *p*-value was calculated (.05/5 = corrected *p* is .01). Kruskal-Wallis tests were conducted to determine whether the IFRJ categories were significantly different in terms of the presence of risk and protective

Predictive validity of the SAPROF and HCR-20^{V3} factors. Jonckheere's tests were also conducted to explore trends in the presence of risk and protective factors across the IFRJ categories. As multiple comparisons were undertaken, a Bonferroni corrected *p*-value was calculated (.05/3 = corrected *p* is .017).

Power Analysis. Post hoc power analyses were conducted using G*POWER (Faul, Erdfelder, Lang, & Buchner, 2007) to determine the statistical power of the sample to detect a significant difference in the HCR-20^{V3} total score and SAPROF total score between the violent and non-violent groups using non-parametric tests. For the HCR-20^{V3}, the analysis indicated that there was insufficient power (69.0%) to detect the small effect size (*d* = .59). This is likely to be due to limited variability in scores within the Historical scale between the violent and non-violent groups and reflects the nature of the study population and setting. For the SAPROF, analysis indicated the sample had sufficient power (97.0%) to detect the large effect size found (*d* = .93). Results pertaining to the HCR-20^{V3} should therefore be regarded as preliminary and interpreted with caution.

Results

Risk and Protective Factors

Descriptive analysis of the prevalence and distribution of risk and protective factors within the sample indicated that patients tended to have several risk factors and relatively few protective factors (Table 1). There was however evidence of a range of scores across the sample and the full range of response options was also used for the majority of items across both tools. Therefore, whilst there was a tendency towards increased numbers of risk factors and lower numbers of protective factors, there was sufficient variability to suggest that both the HCR-20^{V3} and SAPROF could have utility within the population and differential validity.

Predictive validity of the SAPROF and HCR-20^{V3}

[Insert Table 1 about here]

Analysis of the relationship between protective and risk factors indicated that as the number of risk factors increased, the number of protective factors decreased (Table 2). The total HCR-20^{V3} score showed a significant negative correlation with the total SAPROF score (r_s = -.55, p < .001). Similar results were found for the domains with significant correlations (ranging from r_s = .54 *to* -.61) and therefore regarded as a large effect size (Cohen, 1992). The Historical domain did not significantly correlate with any of the SAPROF domains or the total SAPROF score; the direction of the relationship was also inconsistent, however effect sizes were small (ranging from r_s = -.01 to .16).

[Insert Table 2 about here]

All HCR-20^{V3} and SAPROF scales significantly correlated with the FPJ and IFRJ in the expected direction except the Historical scale of the HCR-20^{V3} and the External scale of the SAPROF (Table 2) (these scales had limited variability in scores). The strongest correlations with the FPJ were the Motivational scale (r_s = .78, p < .001) and the SAPROF total score (r_s = .81, p < .001). For the IFRJ, the Clinical scale (r_s = .68, p < .001) and SAPROF total score (r_s = -.68, p < .001) showed the strongest relationships.

Prevalence and Rates of Violence

Thirty three patients (44.0%) engaged in physical, verbal or sexual violence during the twelve month follow-up period and most (n = 27, 81.8%) were violent within the first six months. The total number of violent incidents during the follow-up period was 408 and the

number of incidents per patient ranged from 0 to 147. Three patients accounted for almost 67.0% of all incidents (*n* = 273); when these three patients were excluded from analysis, the mean number of violent incidents per patient was 1.88 (*SD* = 3.66, range 0 – 19).

Violent behaviour was generally directed towards members of staff. Twenty nine patients (38.7%) engaged in physical violence; this was the most frequent type of violence accounting for 68.1% (*n* = 278) of all violent incidents. Patients were most likely to engage in physical violence of a moderate severity and only three patients engaged in serious physical violence. Twenty two patients (29.3%) were noted to be verbally violent during the follow-up period with verbal violence accounting for 27.0% (*n* = 110) of all incidents. Seven patients (9.3%) behaved in a sexually violent way which accounted for 5.6% (*n* = 23) of all violent incidents. These incidents typically involved threats (of sexual violence), comments using sexualised language, or indecent exposure behaviour. In addition to incidents of violence, 30 patients (40.0%) were noted to have behaved in a disruptive way. In total, 124 incidents of disruptive behaviour were recorded with incidents most likely to occur within the first six months of the follow-up period.

Relationship between Risk and Protective Factors and Violence

Across the total and domain scores of the HCR-20^{V3} and SAPROF, the violent group scored significantly higher on the HCR-20^{V3} (indicating increased presence of risk factors) and lower on the SAPROF (indicating fewer protective factors). For the HCR-20^{V3} total score, the difference between the violent group (mean = 26.14, *SD* = 2.97; median = 26, range 20 – 32) and non-violent group (mean = 23.67, *SD* = 5.1; median = 25, range 8 – 31) was significant (*U* = 501.50, *z* = -2.05, *p* = .040). Similarly, for the total SAPROF score, the violent group (mean

= 10.17, *SD* = 2.66; median = 10, range 6 – 20) and non-violent group (mean = 13.37, *SD* = 4.05; median = 13, range 7 – 24) were significantly different (*U* = 355.50, *z* = -3.62, *p* < .001).

The direction and strength of the relationship between the risk and protective factors and presence of violence or disruptive behaviour was explored (Table 2). The Historical scale displayed a non-significant negative correlation with all types of violence and disruptive behaviour; whilst this would suggest that having a higher number of risk factors on this scale was associated with a reduced likelihood of violence, the strength of the relationship was small (less than r_s = .20). The total HCR-20^{V3} score and the Clinical and Risk Management scale scores were positively correlated with all types of violence and disruptive behaviour and a small to medium effect was noted. After applying the Bonferroni correction, significant relationships ranged from r_s = .40 to .44.

In relation to protective factors, the SAPROF total and domain scores correlated negatively with all types of violence and disruptive behaviour indicating that the presence of fewer protective factors was associated with increased likelihood of violence. Effect sizes were in the small to medium range. Only the correlation between the total SAPROF score and the any violence category was significant after application of the Bonferroni correction (r_s = -.42).

Overall, whilst increased numbers of risk factors and fewer numbers of protective factors were generally associated with increased likelihood of violence, the domains appeared to only account for a limited amount of the variance (40 to 44% based on statistically significant correlations).

Predictive Validity of HCR-20^{V3}, SAPROF and SPJ Estimates

Predictive validity of the SAPROF and HCR-20^{V3}

Results of the ROC curve analysis are presented in Table 3. In relation to risk factors, the HCR-20^{V3} total score significantly predicted any violence (AUC = .64, p = .041, 95% CI = .51-.76) and disruptive behaviour (AUC = .70, p = .004, 95% CI = .58-.82) but did not significantly predict the different sub-types of violence. Further, the confidence intervals were large suggesting relatively poor precision. The Historical scale, consistent with the findings of the correlation analyses, had AUC values less than .50 suggesting that the risk factors within this domain were associated with the absence of, rather than presence of, violence. The Clinical scale of the HCR-20^{V3} appeared to predict all types of violence and disruptive behaviour; AUC values for the Clinical scale ranged between .66 (p = .024, 95% CI = .48-.77) for physical violence to .83 (p = .004, 95% CI = .74-.93) for sexual violence. The Risk Management scale also predicted most types of violence and disruptive behaviour with significant AUC values ranging from .64 (p = .042, 95% CI = .52-.77) for physical violence to .75 (p < .001, 95% CI = .64-.86) for disruptive behaviour. These results suggest that dynamic risk factors may be good predictors of future inpatient violence, particularly those relating to current psychosocial functioning. However, similar to the total HCR-20^{V3} score, confidence interval ranges for the Clinical and Risk Management scale had a tendency to be large.

[Insert Table 3 about here]

The SAPROF total predicted the absence of all types of violence (except sexual violence) and disruptive behaviour, with AUCs ranging from .69 (p = .012, 95% CI = .56-.81) for verbal violence to .74 (p < .001, 95% CI = .63-.86) for the category any violence, suggesting that higher numbers of protective factors reduce the risk of violent or disruptive behaviour. Similar to the results of the HCR-20^{V3}, confidence intervals were large suggesting limited

precision. The External scale of the SAPROF was a poor predictor of absence of most types of violence in the inpatient setting. The Internal and Motivational scales appeared to perform similarly to the HCR-20^{V3} Clinical and Risk Management scales and were significant predictors of most types of violence. Although the Internal and Motivational scales of the SAPROF were relatively consistent across most types of violence, the confidence intervals were large with the lower confidence interval value typically around .50 (i.e., chance level). In contrast, the FPJ based was a consistent and significant predictor across all types of violence and disruptive behaviour with AUC values ranging from .72 (p = .003, 95% CI = .60-.84) for verbal violence to .78 (p < .001, 95% CI = .68-.88) for disruptive behaviour.

The HCR-20^{V3} total – SAPROF total variable significantly predicted all types of violence, (except sexual violence) and disruptive behaviour with AUC values ranging from .67 (p = .016, 95% CI = .55-.79) for physical violence to .73 (p = .001, 95% CI = .62-.84) for disruptive behaviour. Confidence intervals were often large and around chance at the lower end of the range.

The IFRJ however was the strongest predictor of the presence of inpatient violence within the sample; it was significantly associated with all types of inpatient violence and disruptive behaviour with AUC values ranging from .74 (p = .001, 95% CI = .63-85) for physical violence to .81 (p < .001, 95% CI = .72-.91) for disruptive behaviour. For the category of any violence, the IFRJ AUC value was .80 (p < .001, 95% CI = .70-.90); therefore a patient selected at random from within the violent group would have a higher risk classification judgment 80% of the time compared to a patient selected at random from within the non-violent group. Whilst confidence intervals were large, for the IFRJ the range was .63 or above suggesting a robust effect. IFRJ AUC values and significance levels were

Predictive validity of the SAPROF and HCR-20^{V3}

also greater compared to the HCR-20^{V3} total – SAPROF total variable providing some support for the SPJ approach.

Positive and negative predictive values were calculated for the IFRJ across all types of violence and disruptive behaviour (see Table 4). Dichotomising IFRJ risk ratings as either low or moderate/high, produced high NPV and sensitivity (93.1-100%) but low specificity (26.5-40%) and PPV (12.3-54.4%), particularly for sexual violence. Dichotomising patients as low/moderate or high risk resulted in higher accuracy across all offence categories (72-77.3%) with higher specificity than sensitivity for all categories of violence with the exception of sexual violence. Estimates of low risk were more likely to be accurate than those of high risk, with negative predictive values (NPV) reaching 75.5% and above. Positive predictive values varied widely but were higher when using the high/low-moderate dichotomy (23.1-80.8%).

[Insert Table 4 about here]

Incremental Validity of SAPROF and SPJ Risk Estimate

A hierarchical logistic regression explored whether the SAPROF total score and IFRJ added to the predictive validity of the dynamic risk factors in the HCR-20^{V3} for the prediction of any violence (Table 5).

[Insert Table 5 about here]

Dynamic risk factors (Block 1) significantly predicted any type of violence ($\chi^2 = 13.87$, $p <$ .001, $R^2 = .17$-$.23$) and correctly classified 70.7% of cases. When the SAPROF was added

(Block 2), the model was also significant (χ^2 = 17.10, p < .001, R^2 = .20-.27). Although there was some improvement in the model in that there was less unexplained variance, this improvement did not reach statistical significance (change χ^2 3.23, p = .072) and only 68.0% of cases were correctly classified; therefore adding protective factors did not significantly improve the prediction of violence from the dynamic risk factors alone. Further, neither dynamic risk factors nor protective factors were significant predictors in the model and the lower ends of the confidence intervals were slightly below one suggesting that they were not robust predictors or it was difficult to distinguish between the two. Correlational analysis indicated that HCR-20 dynamic risk factors were highly correlated with the SAPROF total (reverse scored) (r_s = .72, p < .001); therefore, whilst inclusion of protective factors did not add predictive power, the degree of correlation suggests it is difficult to ascertain which type of predictor (risk or protective factors) is contributing most to the model. The odds ratio for the SAPROF total (1.20) was comparable to that for the HCR-20^{V3} dynamic factors (1.17).

Adding the IFRJ (Block 3) resulted in the model with the best fit (χ^2 = 26.46, p < .001, R^2 = .30-.40); this was a significant improvement from the risk and protective factors alone (change χ^2 = 9.36, p = .009) and the IFRJ overall was significant (Wald = 8.16, p = .017). The difference between moderate and low risk was negatively associated with violence indicating that a shift in IFRJ rating from moderate to low risk was associated with less violent behaviour. This however did not reach statistical significance (b = -1.62, SE = .92, Wald = 1.61, p = .205); this could reflect a lack of precision within the moderate risk category or the relatively low sample size within each risk category. The difference between moderate and high risk did significantly predict violence and was the only significant predictor in the model (b = 1.92, SE = .75, Wald = 6.44, p = .011) suggesting that an IFRJ of

high risk has utility as a predictor of violence. Further, the odds ratio indicated that with an increase in estimated risk level from moderate to high risk, the odds of an individual engaging in violence were 6.79 times higher. The large confidence interval with lower figure of 1.55 suggests that this result should be interpreted with caution. Dynamic risk factors, protective factors and the SPJ estimate of risk correctly classified 77.3% of cases and accounted for up to 39% of the variance in violent behaviour (R^2 = .29-.39).

Similar results were obtained for a hierarchical logistic regression exploring the prediction of disruptive behaviour, however the HCR-20^{V3} dynamic risk factors remained a significant predictor when the SAPROF protective factors were added to the model. The model incorporating HCR-20^{V3} dynamic risk factors, the SAPROF and the IFRJ provided the best fit (-2 Log Likelihood = 68.37, χ^2 (4) = 32.58, p < .001, R^2 = .35-.48) and correctly classified 76.0% of cases. The IFRJ was not significant within this model (Wald = 3.28, p = .194), however the moderate vs high risk category predictor did approach statistical significance (b = 1.36, SE = .75, Wald = 3.28, p = .070).

SPJ Risk Estimates

Given the relatively higher AUC values for the IFRJ and incremental predictive validity of the IFRJ in predicting violence, post-hoc analyses were conducted to explore the IFRJ categories. Most patients (n = 31, 41.3%) were rated as moderate risk of engaging in inpatient violence, 26 (34.7%) were judged to be high risk and 18 (24.0%) were rated as low risk.

Table 6 shows the rates of violence across each IFRJ category. Across all types of violence and disruptive behaviour, rates of violence (based on the number of patients engaging in violence) were highest within the high risk IFRJ category and lowest in the low risk IFRJ

category. The false positive rate was low with only two patients rated as low risk engaging in any violence; these patients engaged in one incident of violence each which was of a minor or moderate severity.

[Insert Table 6 about here]

Analysis indicated that the rate of violence was significantly associated with the IFRJ categories for all types of violence and disruptive behaviour (any violence: $\chi^2(2) = 23.90$, $p < .001$; physical violence: $\chi^2(2) = 14.13$, $p = .001$; verbal violence: $\chi^2(2) = 18.24$, $p < .001$; sexual violence: $\chi^2(2) = 9.02$, $p = .015$; and disruptive behaviour: $\chi^2(2) = 24.12$, $p < .001$). Sexual violence was not statistically significant after application of the Bonferroni corrected p value ($p = .01$); this is likely to be due to low expected cell frequency values as a result of the low base rate of sexual violence within the sample. Based on the standardised residuals, for all types of violence and disruptive behaviour, the high risk category was significantly associated with violence with more patients engaging in violence than expected in this category (this ranged from $z = 2.2$, $p < .05$ for physical violence to $z = 2.8$, $p < .01$ for any violence). A similar trend was evident for the low risk category with significantly fewer patients engaging in violence than expected for any violence, verbal violence and disruptive behaviour (with scores ranging from $z = 2.1$, $p < .05$ for any violence to $z = 2.2$, $p < .01$ for disruptive behaviour). For all types of violence and disruptive behaviour, the moderate IFRJ rating was not significantly associated with whether the patient engaged in violent behaviour or not suggesting that the precision of this category is relatively poor. In relation to the category 'any violence', the odds of a patient being violent were 33.6 times higher for patients rated as high risk compared to those rated as low risk.

Predictive validity of the SAPROF and HCR-20^{V3}

[Insert Table 7 about here]

The pattern of risk and protective factors was also consistent across the risk categories with higher risk categories having significantly more risk factors and fewer protective factors (Table 7) (HCR-20^{V3} total: $H(2) = 15.69$, $p < .001$; $J = 1304.50$, $z = 3.82$, $p < .001$, $r = .44$; HCR-20^{V3} dynamic: $H(2) = 39.37$, $p < .001$; $J = 1583.00$, $z = 6.57$, $p > .001$, $r = .80$; SAPROF total: $H(2) = 35.45$ $p < .001$; $J = 288.50$, $z = -6.18$, $p < .001$, $r = .71$ with Bonferroni corrected $p = .017$). Although there was considerable overlap in the ranges of scores for each IFRJ category, the effect sizes found for the HCR-20^{V3} dynamic score ($r = .80$) and SAPROF total score ($r = .71$) were large suggesting this is a robust finding.

Discussion

Predictive Validity of Protective Factors for Violence Risk

This study aimed to explore the predictive validity of protective factors for violence within a forensic mental health inpatient setting using the SAPROF. The results supported the hypothesis that the presence of protective factors predicts the absence of inpatient violence. SPJ risk estimates of the overall protection offered by the protective factors (the FPJ) were also significantly associated with the absence of all types of violence and disruptive behaviour. In predicting the absence of any violence, the SAPROF total AUC was .74 and the FPJ was .76. The results were therefore comparable to the findings of de Vries Robbé (2014) who also explored protective factors for inpatient aggression.

None of the SAPROF subscales or total score significantly predicted the absence of sexual violence. This may have been due to the relatively low base rate for sexual violence within the sample and broad definition used which included relatively minor forms of

inappropriate sexualised behaviour. It is also possible that sexual aggression is qualitatively different and may require consideration of different protective factors that are not included in the SAPROF. A SAPROF manual focusing specifically on protective factors associated with sexual violence is currently in development.

The relevance of some of the items in the SAPROF within a secure inpatient setting is also unclear; for example the need for Financial Management may be limited and sustaining an Intimate Relationship may be problematic depending on what restrictions are in place. The External scale of the SAPROF was a poor predictor of absence of most types of violence; this is likely to be due to the limited variability in scores within this domain as three of the items are rated the same for all patients due to the nature of the secure environment.

The predictive validity of the total and domain scores in the HCR-20^{V3} varied in the current study. Post hoc power analyses indicated the study lacked the statistical power to identify a small effect in relation to the HCR-20^{V3} total score, however some preliminary observations are noted. Although the HCR-20^{V3} total score predicted the category of any violence, the AUC was relatively low at .64 and the HCR-20^{V3} total score failed to significantly predict any of the sub-types of violence. However, it was apparent from analysis of the HCR-20^{V3} domains that the Historical scale was a particularly poor predictor whilst the dynamic Clinical and Risk Management scales fared better. Although previous meta-analytic reviews would suggest that historical and static factors are often the strongest predictors of violent behaviour (Bonta, Law, & Hanson, 1998; Campbell et al., 2009), studies utilising the previous version of HCR-20 have also found that the dynamic risk factors had more predictive validity than the historical factors (Belfrage, Fransson, & Strand, 2000; O'Shea et al., 2013; Strand et al., 1999). All of these studies highlight limited variability in Historical scale risk factors within the samples which was true of the present sample

where, due to the nature of the population and secure setting, the majority of patients presented with a high number of historical risk factors. Dynamic factors may also have had a greater association with violence in the current study due to the relatively short follow-up period with dynamic factors being more current and relevant within the follow-up period. The results of the HCR-20^{V3} should be interpreted with caution for a number of reasons. Firstly, there was limited statistical power in relation to the HCR-20^{V3} which is likely to be due to the homogeneity within the sample. Secondly, in the present study, the Personality Disorder item in the Historical scale of the HCR-20^{V3} was excluded due to limited information; personality disorder has been shown to be associated with increased risk for violent and antisocial behaviour (Yu, Geddes, & Fazel, 2012) and therefore it is possible that the predictive accuracy of the Historical scale was reduced by excluding this item. Finally, only presence ratings were noted in the current study and it is possible that consideration of the relevance of the risk factors may enhance the predictive validity of the HCR-20^{V3}. Despite these limitations, the current study suggested that the HCR-20^{V3} does have some utility in predicting inpatient violence. This is in contrast to a previous study (Vojt, et al., 2013) which was conducted in the same setting. This previous study however was based on clinical team ratings of the HCR-20 risk factors which may have included an element of bias (as patients were well known to team members) and utilised a definition of violence which was not based on the HCR-20 manual definition. Further, only patients who provided consent were included whereas the current study used a total cohort sample; Vojt et al. (2013) noted that those who did not take part in their study had significantly higher scores on the HCR-20 suggesting that their sample may not have been representative.

The current study hypothesised that the SAPROF would have incremental validity in relation to predictive accuracy when added to the HCR-20^{V3}. The results of the hierarchical

regression analyses suggested that although the combined model which included the HCR-20^{V3} dynamic risk factors and SAPROF was significant and there was less unexplained variance than when only risk factors were considered, the SAPROF did not significantly add to the predictive validity of the HCR-20^{V3} for violence and disruptive behaviour within the hospital setting. This may reflect a degree of overlap in the content of some of the items within the HCR-20^{V3} and SAPROF (as noted by Guy, 2008 based on the initial version of the SAPROF). Further, the SAPROF and HCR-20^{V3} were highly correlated which made it difficult to determine the relative contribution of risk and protective factors. Whilst the results did not establish the utility of adding structured assessment of protective factors to the violence risk assessment process in terms of the predictive validity of the assessment, consideration of protective factors may have other benefits in terms of informing treatment by highlighting targets of intervention or facilitating engagement in those being assessed. It is therefore important that the other aspects of protective factors are explored before drawing conclusions on the utility of incorporating protective factors in violence risk assessment practice.

The present study found moderate to high correlations between HCR-20^{V3} dynamic risk factors and SAPROF protective factors. This, coupled with the SAPROF's lack of incremental validity suggests that the HCR-20^{V3} may already be capturing some of the protective factors in the SAPROF. The absence of a clear theoretical framework regarding how protective factors function to reduce risk also makes it more challenging to delineate their role and support their inclusion in violence risk assessment and practice. However, the greater predictive accuracy of the IFRJ, which also incorporates protective factors, does suggest a role for at least some protective factors. The potential reframing of some existing risk factors to also highlight their protective or strength based role (as in the START assessment)

may have benefits, particularly in terms of identifying treatment and interventions and establishing meaningful engagement with patients.

The HCR-20^{V3} total – SAPROF total variable significantly predicted all types of violence except sexual violence, however confidence intervals were large and the variable accounted for little variance in violence outcome. This would suggest that the relationship between risk and protective factors and underpinning mechanisms between protective factors and violence is complex and not adequately captured by simply subtracting the numerical scores of protective factors from those risk factors.

Some support was found for the validity of the SPJ overall risk estimate. The IFRJ significantly and robustly predicted all types of violence and disruptive behaviour (with AUC values ranging from .74 to .81). This is consistent with previous findings; Guy (2008) conducted a meta-analysis of the SPJ approach to violence risk assessment and concluded that SPJ ratings tended to have higher predictive validity compared to total scores. There was also preliminary support for the study hypothesis that the SPJ risk estimate would have incremental validity over the HCR-20^{V3} risk factor ratings; the IFRJ significantly added to the predictive validity of the dynamic factors in the HCR-20^{V3} and the protective factors in the SAPROF in relation to violence and disruptive behaviour. In particular, an IFRJ rating of high risk was significantly associated with increased likelihood of violence (however the large confidence interval suggests this result should be interpreted with caution). Further analyses found that IFRJ categories were significantly different in terms of rates of violence and disruptive behaviour and higher risk ratings were associated with significantly more risk factors and fewer protective factors. There is no clear guidance regarding how to derive SPJ risk estimates, however it is likely that the IFRJ ratings incorporated consideration of both risk and protective factors as the HCR-20^{V3} and SAPROF totals were significantly correlated

Predictive validity of the SAPROF and HCR-20^{V3}

with the IFRJ ratings. Further, as the IFRJ also appeared to be a stronger predictor than the HCR-20^{V3} total – SAPROF total it is possible that the IFRJ was able to capture some of the complexity in the relationship between risk and protective factors.

Despite the model which included dynamic risk factors, protective factors and the SPJ risk estimate correctly classifying 77.3% of cases, it was noted that this model only accounted for 39% of the variance in inpatient violence; other situational and environmental variables may therefore also be important within institutional settings (Welsh, Bader, & Evans, 2013). As in all studies of this nature, the opportunity for patients to commit acts of violence will have been limited due to implementation of risk management strategies within the secure forensic setting. Therefore, the predictive validity and accuracy of the tools may be under estimated.

The utility of the IFRJ in identifying individuals at higher or lower risk of engaging in violence during the follow up period was also examined. It proved most accurate in identifying those at high risk of any violence achieving both high specificity and positive predictive value while maintaining an adequate sensitivity. Eighty-one percent of those judged as high risk committed an act of violence while 76% of those considered low or moderate risk did not. Sixty-four percent of individuals who acted violently were identified as high risk and 88% of those deemed low or moderate risk did not engage in violence during the follow up period.

Strengths and Limitations

This study represented a total cohort sample of all participants who met the study inclusion criteria. Ratings were made by an independent researcher, therefore reducing potential biases associated with clinician and team ratings. In addition to violent behaviour,

the current study also considered the category of disruptive behaviour which is likely to have a significant personal and organisational impact within the hospital setting.

There is clear interest in protective factors and the SAPROF has been implemented in practice despite the relatively limited empirical evidence base. The present study therefore adds to the existing research on the SAPROF as well as highlighting areas for further research. In particular, further research is required to establish whether additional structured assessment of protective factors is necessary or whether existing risk factors can be reconceptualised to also capture protective factors. Whereas some previous studies exploring the predictive validity of violence risk assessment tools have focused on the total and domain scores, this study also explored the validity of and found support for the SPJ ratings (the FPJ and IFRJ). This study also explored the utility of the SAPROF in combination with the most recent version of the HCR-20 risk assessment tool.

There are a number of limitations which should also be highlighted. Firstly, the HCR-20^{V3} and SAPROF were scored retrospectively from file information. Although file-based studies are generally acknowledged as acceptable in the initial validation stages of new tools (Douglas, Hart, et al., 2013), in professional practice a combination of different methods such as interview and file information are generally used. Further, although the file information was comprehensive, it was not possible to score some items due to limited information or a lack of formal assessment. There may also have been a tendency for retrospective file information to focus on risk factors as consideration of protective factors in violence risk assessment is relatively new. Although the HCR-20^{V3} and SAPROF were coded 'blind' to the outcome, prospective designs are required to robustly establish the temporal sequence required when drawing conclusions about predictive relationships. The study also relied on incidents of violence recorded by staff as the outcome measure; whilst there are

procedures in place to ensure adverse incidents are accurately recorded within the hospital, it is possible that some incidents were not recorded on the system as this decision may be influenced by a number of factors, including staff perception of the incident and whether staff observed the incident.

Due to the timeframes utilised, all patients had been detained in the hospital for at least one year prior to the beginning of the outcome period, therefore it is not possible to determine whether the SAPROF may have predictive utility during the admission phase which may be characterised by more instability in mental health and therefore possibly an increased risk of violence.

It was also not possible to assess interrater reliability. As the HCR-20^{V3} and SAPROF was scored by a single rater, potential rater biases were reduced. However, the findings require to be replicated in clinical practice where tools are often rated by different raters or by teams. De Vogel and de Ruiter (2004) have also demonstrated that researchers tended to rate the HCR-20 significantly higher than clinicians who were familiar with the individuals being assessed and involved in their care and treatment. Therefore establishing the utility and ecological validity of the SAPROF and HCR-20^{V3} in practice is essential. Similarly, although the SPJ ratings were shown to be associated with violence, this requires to be replicated by other raters. This is particularly important given the limited guidance regarding how SPJ risk estimates are derived; future research may benefit from exploring the processes involved and how professionals integrate risk factors when deriving SPJ risk estimates in order to operationalise and develop guidance in relation to this.

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Summary

The results suggested that protective factors assessed using the SAPROF were associated with the absence of violence and disruptive behaviour in a forensic mental health inpatient setting. The incremental validity of protective factors was however not established and it remains unclear whether inclusion of structured assessment of protective factors in violence risk assessment improves predictive accuracy. Our results provide evidence to support that a structured professional judgment approach, in the form of the SAPROF's Integrative Final Risk Judgment, results in greater predictive accuracy in the assessment of inpatient violence risk. This overall SPJ estimate of risk was a relatively robust predictor of all types of violence and disruptive behaviour in the sample, with high risk ratings associated with fewer protective factors and a greater number of risk factors. Given the apparent inter-dependence of many existing risk and protective factors, it is suggested that consideration could be given to considering the role of protective factors when using existing tools focusing on risk factors. This would ensure violence risk assessments and overall risk judgments are comprehensive, predictive validity is maximised, a range of targets for intervention can be identified, and a more inspiring treatment framework and management plan for patients could potentially be developed.

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Predictive validity of the SAPROF and HCR-20^{V3}

Table 1. Descriptive Statistics for the HCR-20^{V3} and SAPROF

	Descriptive Statistics			
Risk and Protective factors	*Mean*	*SD*	*Median*	Range
HCR-20^{V3}				
Historical scale	14.35	2.83	15	6-18
Clinical scale	5.73	2.36	6	0-10
Risk Management scale	4.67	1.83	5	1-9
HCR-20^{V3} total	24.75	4.44	25	8-32
SAPROF				
Internal scale	1.68	1.38	2	0-8
Motivational scale	3.36	2.69	3	0-9
External scale	6.92	0.75	7	6-8
SAPROF total	11.96	3.84	11	6-24
HCR-20^{V3} total – SAPROF total	12.79	7.38	14	-8-24

Note: N = 75. HCR-20^{V3} = Historical Clinical Risk Management-20 (version 3); SAPROF = Structured Assessment of Protective Factors; *SD* = standard deviation. In this study, the possible range of scores on the HCR-20^{V3} Historical scale is 0-18; Clinical scale is 0-10; Risk Management scale is 0-10; and HCR-20^{V3} total is 0-38 (higher scores on HCR-20^{V3} scales indicate greater presence of risk factors). The possible range of scores on the SAPROF Internal scale is 0-8; Motivational scale is 0-12; External scale is 6-10; and SAPROF total is 6-30 (higher scores on the SAPROF scales indicate greater presence of protective factors).

Predictive validity of the SAPROF and HCR-20^{V3}

Table 2. Correlations between HCR-20, SAPROF, Structured Professional Judgment (SPJ) Estimates, Violence and Disruptive Behaviour

	Clinical	Risk Management	HCR-20 Total	Internal	Motivational	External	SAPROF Total	FPJ	IFRJ	Violence (any)	Physical Violence	Verbal Violence	Sexual Violence	Disruptive Behaviour
Historical	-.20 (.087)	.14 (.241)	.47* (.000)	-.07 (.536)	.16 (.161)	-.01 (.912)	.10 (.411)	.16 (.177)	-.21 (.075)	-.15 (.203)	-.09 (.442)	-.20 (.091)	-.19 (.104)	-.10 (.377)
Clinical		.47* (.000)	.64* (.000)	-.54* (.000)	-.61* (.000)	-.23 (.044)	-.66* (.000)	-.64* (.000)	.68* (.000)	.37 (.001)	.27 (.021)	.40* (.000)	.34 (.003)	.40* (.000)
Risk Management			.58* (.000)	-.34 (.003)	-.56* (.000)	-.26 (.026)	-.56* (.000)	-.54* (.000)	.52* (.000)	.33 (.004)	.24 (.039)	.24 (.035)	.18 (.123)	.44* (.000)
HCR-20 Total				-.48* (.000)	-.49* (.000)	-.25 (.034)	-.55* (.000)	.49* (.000)	.44* (.000)	.24 (.039)	.16 (.172)	.20 (.082)	.10 (.379)	.34 (.003)
Internal					.42* (.000)	.22 (.061)	.68* (.000)	.56* (.000)	-.51* (.000)	-.32 (.005)	-.28 (.015)	-.19 (.110)	-.16 (.182)	-.28 (.017)
Motivational						.28 (.015)	.91* (.000)	.78* (.000)	-.64* (.000)	-.34 (.003)	-.25 (.028)	-.23 (.045)	-.13 (.280)	-.31 (.008)
External							.49* (.000)	.27 (.019)	-.22 (.059)	-.20 (.086)	-.22 (.063)	-.25 (.032)	-.15 (.189)	-.25 (.031)
SAPROF Total								.81* (.000)	-.68* (.000)	-.42* (.000)	-.35 (.002)	-.29 (.011)	-.20 (.084)	-.38 (.001)
FPJ									-.77* (.000)	-.51* (.000)	-.41* (.000)	-.37 (.001)	-.25 (.030)	-.52* (.000)
IFRJ										.55* (.000)	.43* (.000)	.49* (.000)	.32 (.005)	.57* (.000)
Violence (any)											.90* (.000)	.73* (.000)	.36 (.001)	.81* (.000)
Physical Violence												.57* (.000)	.40* (.000)	.69* (.000)
Verbal Violence													.50* (.000)	.67* (.000)
Sexual Violence														.39 (.000)

Note. N = 75. Spearman's Rho (r_s)correlation (significance level, 2-tailed). HCR-20^{V3} = Historical Clinical Risk Management-20 (version 3). SAPROF = Structured Assessment of Protective Factors. FPJ = Final Protection Judgment. IFRJ = Integrative Final Risk Judgment.

* r_s is significant at the Bonferroni corrected p value .0004 (.05/105).

Predictive validity of the SAPROF and HCR-20^{V3}

Table 3. Predictive Accuracy of HCR-20^{V3}, SAPROF and Structured Professional Judgment Estimates for Violence and Disruptive Behaviour (ROC)

	Outcome									
Risk and protective factors and	Any Violence		Physical Violence		Verbal Violence		Sexual Violence		Disruptive Behaviour	
SPJ estimates	AUC	95% CI	AUC	95% CI	AUC	95% CI	AUC	95% CI	AUC	95% CI
HCR-20^{V3}										
Historical scale	.42	.28-.55	.45	.31-.58	.38	.25-.51	.31	.10-.53	.44	.31-.57
Clinical scale	.71**	.60-.83	.66*	.48-.77	.75***	.63-.87	.83**	.74-.93	.73***	.62-.85
Risk Management scale	.69**	.55-.82	.64*	.52-.77	.65*	.53-.78	.68	.53-.83	.75***	.64-.86
HCR-20^{V3} total	.64*	.51-.76	.59	.47-.72	.63	.50-.75	.60	.41-.80	.70**	.58-.82
SAPROF										
Internal scale	.68**	.56-.80	.66*	.54-.78	.61	.48-.75	.65	.44-.85	.66*	.53-.78
Motivational scale	.70**	.58-.81	.65*	.53-.77	.65*	.52-.77	.62	.47-.78	.68**	.56-.80
External scale	.61	.48-.74	.62	.48-.75	.65*	.51-.79	.64	.42-.86	.64*	.50-.77
SAPROF total	.74***	.63-.86	.71**	.59-.82	.69**	.56-.81	.70	.53-.87	.72***	.60-.84
Final Protection Judgment	.76***	.67-.88	.73***	.61-.84	.72**	.60-.84	.73*	.57-.89	.78***	.68-.88
HCR-20^{V3} total - SAPROF total	.71**	.60-.83	.67*	.55-.79	.67*	.55-.79	.67	.50-.83	.73***	.62-.84
Integrative Final Risk Judgment	.80***	.70-.90	.74***	.63-.85	.79***	.68-.90	.80**	.66-.94	.81***	.72-.91

Note. N = 75. HCR-20^{V3} = Historical Clinical Risk Management-20 (version 3); SAPROF = Structured Assessment of Protective Factors; AUC = area under the curve (from Receiver Operating Characteristic (ROC) curve analysis; CI = confidence interval. The values for the HCR-20^{v3} scales and total, HCR-20^{v3} total – SAPROF total, and Integrative Final Risk Judgment concern the presence of violence. The values for the SAPROF scales and total and Final Protection Judgment concern the absence of violence.
* $p < .05$; * $p < .01$; *** $p \leq .001$ (two-tailed)

Predictive validity of the SAPROF and HCR-20^{V3}

Table 4: Predictive Accuracy of HCR-20^{V3}, SAPROF and Structured Professional Judgment Estimates for Violence and Disruptive Behaviour (Positive Predictive Values and Negative Predictive Values)

	Bin 1 – High Vs Low/Moderate					Bin 2 – Low Vs High/Moderate				
	PPV (%high risk and violent)	NPV (%low risk and not violent)	Sensitivity	Specificity	Accuracy	PPV (%high risk and violent)	NPV (%low risk and not violent)	Sensitivity	Specificity	Accuracy
Any violence	80.8	75.5	63.6	88.1	77.3	54.4	88.9	93.9	38.1	62.7
Physical violence	65.4	75.5	58.6	80.4	72.0	47.4	88.9	93.1	34.8	57.3
Verbal violence	57.7	85.7	68.2	79.3	76.0	38.6	100	100	34.0	53.3
Sexual violence	23.1	98.0	85.7	70.6	72.0	12.3	100	85.7	70.6	72.0
Disruptive behaviour	73.1	77.6	63.3	84.4	76.0	52.6	100	100	40.0	64.0

Note. PPV = Positive Predictive Values; NPV = Negative Predictive Values

Predictive validity of the SAPROF and HCR-20^{V3}

Table 5. Hierarchical Logistic Regression for Violence Exploring Incremental Validity of SAPROF Protective Factors and Integrated Final Risk Judgment (IFRJ) over HCR-20^{V3} Dynamic Risk Factors

	Regression Coefficient			Odds Ratio		Model			
Model	*b*	SE	Wald	Exp (*B*)	95% CI	-2 Log Likelihood	Model χ^2 (*df*)	R^2_{CS}-R^2_N	Change (from previous block) χ^2 (*df*)
Constant	-0.24	.23	1.08	.79		102.89			
Block 1						89.02	13.87(1)***	.17 -.23	13.87(1)***
HCR-20^{V3} dynamic	0.28	.88	10.43***	1.33	1.12-1.57				
Block 2						85.79	17.10(2)***	.20-.27	3.23(1)
HCR-20^{V3} dynamic	0.16	.11	2.06	1.17	0.94-1.46				
SAPROF total	0.18	.11	2.82	1.20	0.97-1.48				
Block 3						76.43	26.46(3)***	.30-.40	9.36(1)**
HCR-20^{V3} dynamic	-0.01	.13	0.001	1.00	0.78-1.27				
SAPROF total	0.08	.12	0.46	1.08	0.86-1.36				
Integrative Final Risk Judgment			8.16*	5.09	1.60-16.23				
Low vs Moderate risk	-1.16	.92	1.61	0.31	0.52-1.88				
High vs Moderate risk	1.92	.75	6.44*	6.79	1.55-29.78				

Note. N = 75. HCR-20^{V3} = Historical Clinical Risk Management-20 (version 3); SAPROF = Structured Assessment of Protective Factors; SE = standard error; CI = confidence interval; R^2_{CS} = Cox & Snell; R^2_N = Naglekerke. HCR-20^{V3} dynamic includes Clinical and Risk Management scale risk factors. SAPROF total is reverse scored.
* $p < .05$; * $p < .01$; *** $p \leq .001$

Table 6. Rates of Violence and Disruptive Behaviour across Integrative Final Risk Judgment (IFRJ) Categories

	Integrative Final Risk Judgment (IFRJ) categories		
	High (*n* = 26)	Moderate (*n* = 31)	Low (*n* = 18)
Type of violence	*N* (%)	*N* (%)	*N* (%)
Any violence (*n* = 33)	21 (63.6%)	10 (30.3%)	2 (6.1%)
Physical violence (*n* = 29)	17 (58.6%)	10 (34.5%)	2 (6.9%)
Verbal violence (*n* = 22)	15 (68.2%)	7 (31.8%)	0
Sexual violence (*n* = 7)	6 (85.7%)	1 (14.3%)	0
Disruptive behaviour (*n* = 30)	19 (63.3%)	11 (36.7%)	0

Predictive validity of the SAPROF and HCR-20^{V3}

Table 7. Descriptive Statistics for HCR-20^{V3} and SAPROF across Integrative Final Risk Judgment (IFRJ) Categories

	Integrative Final Risk Judgment (IFRJ) Categories					
	High (*n* = 26)		Moderate (*n* = 31)		Low (*n* = 18)	
	Mean (*SD*)	Median (range)	Mean (*SD*)	Median (range)	Mean (*SD*)	Median (range)
HCR-20^{V3} total	26.57 (2.70)	26.75 (23-31)	25.42 (3.22)	25 (18-32)	20.72 (5.73)	21 (8-29)
HCR-20^{V3} dynamic	13.42 (1.82)	13 (10-18)	9.97 (2.88)	10 (2-16)	6.78 (3.15)	7 (2-13)
SAPROF total	8.87 (1.59)	9 (6-12)	12.61 (3.19)	12 (7-20)	15.32 (3.90)	15 (7-24)

Note: HCR-20^{V3} = Historical Clinical Risk Management-20 (version 3); SAPROF = Structured Assessment of Protective Factors; *SD* = standard deviation. In this study, the possible range of scores on the HCR-20^{V3} total is 0-38; HCR-20^{V3} dynamic is the Clinical and Risk Management scales combined and has a possible range of 0-20 (with higher scores on the HCR-20^{V3} indicating greater presence of risk factors). The possible range of scores on SAPROF total is 6-30 (higher scores on the SAPROF scales indicate greater presence of protective factors).